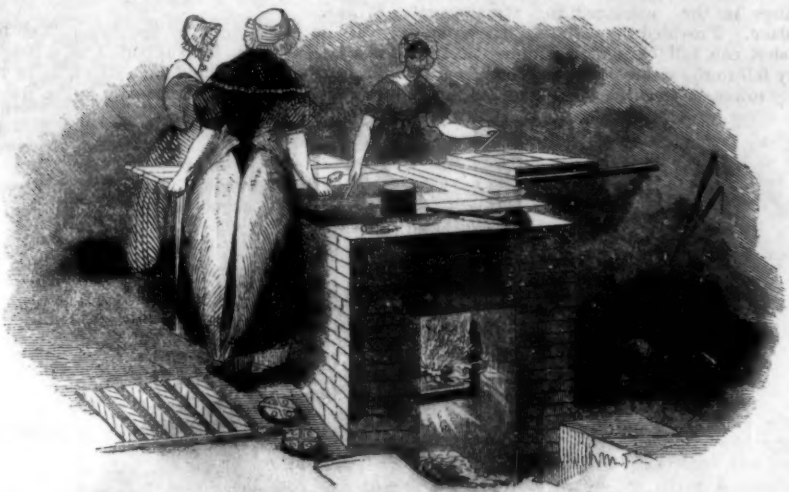
A DAY AT THE TYNE FACTORIES.



[Casting Lead into flat Moulds for White-lead Manufacture.]

THE Chemical Works and the Glass-Factory, noticed in two of our recent Supplements, are instances of the busy connection which subsists between the various manufacturing towns on the banks of the Tyne. Newcastle, Wallsend, North Shields, and other places on the north bank; Gateshead, Felling, South Shields, and others on the south bank—are all so linked together in respect to their manufacturing and commercial arrangements, that we may almost regard them as one town. It is in this sense that we use the designation "Tyne Factories," in reference to a few brief notices which we have yet to give.

Among the establishments at Newcastle to which we have been favoured with access, and which are fitted to illustrate branches of manufacture not yet noticed in this Magazine, are the

Gallowgate Lead-Works.

Gallowgate is the name of one of the older or main streets in the northern part of Newcastle; a street which has not yet come within the scope of the magnificent improvements planned and carried out by Mr. Grainger in the central parts of the town, and of which an account was given a few years back in vol. ix. (1840). The term 'Lead-Works' is a short and convenient one, but it would not in itself convey an exact idea of the operations carried on. The establishment in question is a shot-factory, a refinery, a white-lead factory, and a red-lead factory; but all of these have the metal lead for the basis of operations, and therefore the general name becomes a fitting one.

Like most large factories, there is here within the entrance-gates an open court surrounded with buildings in which the manufacturing processes are carried on; some have the comparatively simple apparatus connected with the white-lead manufacture; some the ranges of furnaces for the red lead; some the very curious arrangements pertaining to the shot process; some the large vessels in which silver is obtained from masses of lead; while the group of buildings as a whole illustrates the differences observable as to the employment of men or of women in different processes of manufacture. We will first watch the proceedings of the

Shot-manufacture.—The little spherical shot so familiar to the soldier and the sportsman are produced in a very singular way. Those of large size, such as pistol bullets and rifle balls, being required of regular and exactly equal size, are generally cast in a mould, one at a time, in the same way as other small specimens of casting. Shot of the next smaller size, such as swan-shot, are often produced by casting several at a time; there is a double mould formed, something like a pair of nut-crackers, which, when closed, exhibits a range of little moulds into which the melted lead can be poured, and, when open, allows the shot so made to be removed from the mould. Another mode of making shot is by rolling: a piece of thin lead is cut up into little cubes, and these are placed between two flat stones, the upper of which works over the lower; so that by the pressure and the movement the cubical fragments are worn to a spherical shape. A ruder kind is sometimes made by shaking a number of small fragments of lead together in a bag or box, by which the corners and rough edges are worn away, and an approximate roundness given to the pieces; just in the way that boys' marbles are made. But the most effective and the most highly curious mode now adopted of making the smaller shot is by *granulation*, that is, by allowing melted lead to fall through a series of holes in a kind of colander, and causing the drops thus formed to pass through a considerable space before they finally settle in a vessel of water beneath; the distance being such as to enable the drops to cool and solidify before they reach the bottom. When this plan was first adopted, the shots fell into water almost immediately on passing through the holes; but they were misshapen by this sudden immersion. The first person who worked out the idea of causing the drops to fall through a considerable space was a plumber at Bristol named Watts; and a little tinge of the marvellous accompanies the account given of the invention. This plumber, in the year 1782, is said to have "dreamed" that he made shot by such a method; and he accordingly tried the experiment from the tower of

St. Mary Redcliffe church at Bristol. He succeeded; he sold the invention for a very large sum, planned a magnificent crescent at Bristol, spent all the money in merely preparing the foundations for this crescent, and thus gave origin to a spot which long afterwards bore the name of "Watts's Folly." In more recent times a curious change in the manufacturing arrangements has taken place. Provided the vertical space through which the shot can fall be sufficient, it matters not whether they fall to the surface of the ground from the top of a lofty tower, or *from* the surface of the ground into a pit beneath. The plan originally acted on was the first, of which there is a very elegant specimen in the shot-tower near the foot of Waterloo Bridge, and another at Newcastle; whereas the second plan, though less attractive to the eye, is equally efficacious and more economical: it is the plan carried on at the Gallowgate Works.

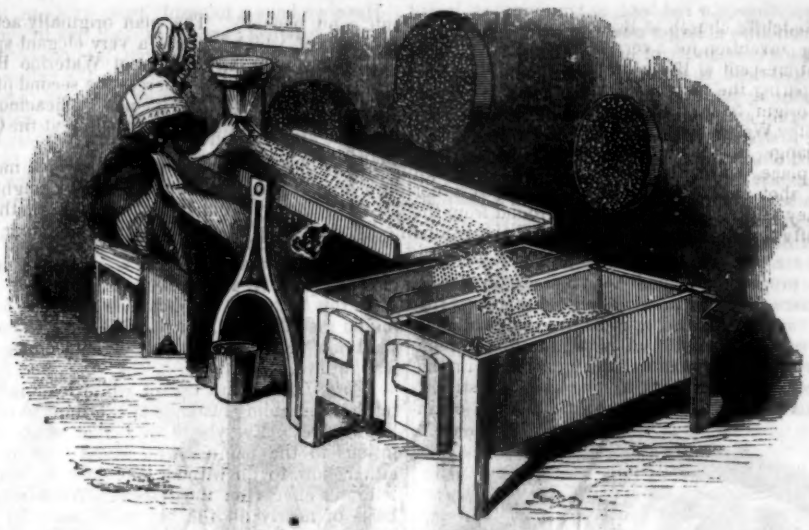
In the shot-factory the first thing which meets the eye is a kind of colander supported at a height of a yard or so from the ground on a stand, as in the annexed cut, and having a circular hole in the floor beneath it.

[Casting Shot.]

This hole is a central opening into a vertical pit two hundred feet deep by six feet in diameter, the mouth of which is at most times closed, with the exception of the small aperture fifteen inches in diameter. What we here call the 'colander' sufficiently resembles in shape the familiar culinary vessel so termed, to be conveniently indicated here by that name; the lower part is pierced with holes; and as the size of these holes determines the size of the shot, there is one colander for each size, of which there are as many as fifteen or sixteen, varying from $\frac{1}{4}$ to $\frac{1}{16}$ of an inch diameter.

Lead shot contains a very small per centage of arsenic, to improve its sphericity and solidity. Near the colander is a small furnace or pot, in which the lead and arsenic are melted; and when the fluid metal is ready, the shot-making at once commences. A layer of dross or scum is laid over the holes in the colander, to act as a kind of filter or strainer, or to separate the liquid metal more effectually into small drops. A man lades the metal out of the pot into the colander, and presently we see a pretty stream of silvery rain descending from the holes in the colander into the pit, through the aperture in the floor; the lead divides into small drops while passing through the dross and the holes, and becomes solid by the time it reaches a vessel of water placed at the bottom of the pit. It might be supposed that the drops would assume an elongated pear shape, or that they would cling together during the descent and form a string of knots; but the composition of the metal, the temperature to which it is heated, the filtering medium put over the holes, and the depth of the descent, are all adjusted for the attainment of a proper sphericity.

When two tons weight of shot have thus fallen into the pit, operations are temporarily suspended; the aperture of the pit is opened, a man is lowered to the bottom, and he sends up all the shot from the water into which they had fallen. The shot are dried by being spread out on steam-heated iron plates; and the different sizes are next separated by sifting through sieves. But with all the care bestowed in the manufacture, imperfect shot are sure to form part of the group: in some specimens two shots cling together; in others the pear shape is exhibited; in others the egg shape; and all these defective shot must be removed. Now this removal is effected by one of the most simple but beautiful contrivances that can be imagined. On one side of the building where these operations are carried on, is a table of highly smoothed and polished iron, capable of being tilted up to any angle, and attended by a woman, to whom the shot are handed up when made, and who sits in front of the apparatus, as in the annexed cut. At one end is a small hopper or receptacle into which the shot are put by this attendant, and from which they descend in a broad stream down upon the table. The table being inclined, they roll down its surface to the lower edge; but in their progress the round and the crooked shot part company. All the well-shapen shot, like good pedestrians, travel regularly down the path, deviating neither to the right nor the left, and reach the bottom in full activity; but the lame or misshapen shot, like bad walkers, waddle from side to side, and waste so much strength that they arrive at the lower end of the table almost spent. What then is the result? The good round shot start from off the table with such force that they descend into a trough removed some little distance from the table; whereas the bad crooked shot fall over the precipice almost vertically into a different trough. So nicely are the angle of the slope and the distance of the troughs regulated, that almost every



[Inclined Plane for separating Shot.]

individual misshapen shot is separated by these means.

The shot retain the dead-white silvery appearance which the melted metal itself had exhibited, but this is exchanged for a darker and more glossy hue before they are brought to market. There is a kind of churn or cast-iron barrel into which the shot are placed with a little plumbago, or black-lead, and by the rotation of this churn for a considerable time the shot give to each other by friction a still more spherical form, and at the same time become coated with a thin and equable layer of black lead, which is rubbed pretty firmly into the surface. They are finally tied up in canvas bags containing two stone, or twenty-eight pounds each, and in that form sent into the market.

Refining.—The refining carried on in connection with the lead manufacture, instructively illustrates the difference in value of various kinds of metal. Most lead, after it has been melted from the ore into the form of oblong blocks or 'pigs,' contains a little silver, and the decision of the question whether or not the silver can profitably be extracted from the lead, depends on the ratio between the one and the other. There is a ratio below which the silver obtained would not pay for the wages and other expenses incurred in the extraction, and in such case the refining process is not carried on; while in some instances the lead is sufficiently rich in silver to yield a handsome return for this process. Sometimes it is found, on assay or analysis, that there is only half an ounce of silver in a ton of lead, while some of the rich veins of lead contain more than a hundred ounces of silver to the ton. If it contains five ounces to the ton (the average of the district being about ten), then it is deemed worth the trouble of refining, where operations are conducted on a large scale.

In order to extract with advantage so small a portion of silver, the manufacturer is indebted to an ingenious process, invented and patented within a few years by Mr. Pattinson of Newcastle. The apparatus consists of a number of large cast-iron pots, holding five or six tons of lead each. In these the lead containing silver is melted, and then suffered to cool slowly, while a workman keeps it continually stirred with an iron tool. As it cools, a kind of crystallization takes place; particles or *crystals* of solid lead fall to the bottom, and are withdrawn by a perforated ladle or colander. These solid particles contain less silver than the original lead, while the remaining fluid part is proportionately enriched. The same operation is repeated again and again upon the remelted crystals, and also upon the residual richer portion, until finally the silver is concentrated into 1-10th or 1-20th of the original bulk of lead, while the remaining part of the lead is almost entirely deprived of the precious metal.

The rich lead thus produced is then subjected to a process called *cupellation*, which consists in heating the metal in a peculiar furnace to a high temperature, and at the same time exposing it to a blast of air, by which the lead is oxidized and comes off as "*Litharge*;" while the silver, not being so acted upon, remains in a mass or cake of great beauty and purity, often weighing several thousand ounces. A singular and brilliant appearance accompanies this process. When the silver is in a melted state, it absorbs between its particles many times its bulk of pure oxygen gas; this gas, as the metal solidifies, is expelled, and, escaping from beneath the hardening surface of the mass, forces with it the yet fluid metal from below, and forms lively representations or *models* of volcanic operations, leaving the surface covered with beautiful and fantastic concretions of pure and brilliant silver.

The *Litharge* is either used in the making of flint-glass, or in preparing the salts of lead, which are much employed in dyeing and calico printing; or, being mixed with coal and heated in a furnace, it parts with the oxygen and resumes the metallic form, being then called *Refined* lead.

The heat required for capellation is so high that much lead is volatilized and lost, and the value of Mr. Pattinson's discovery consists in separating the silver without exposing more than a small proportion of the lead to this wasteful process.

We have next to visit other parts of the factory, and notice the production of two substances extensively used in the arts, by the combination of lead with two other agents. One of these is

Red Lead.—This substance is not so absurdly named as 'black lead' and 'sugar of lead,' the first of which contains no lead, and the second no sugar; but still it is not quite a correct name, for it is lead combined with another agent, which totally destroys its customary metallic quality. Red lead, like the litharge which we have just noticed as resulting from the refining, is a combination of lead with the oxygen of the air, but in

different proportions, for red lead, or 'minium,' as it is also called, contains a larger quantity of oxygen than litharge to a given quantity of lead.

When melted lead is exposed to the action of the atmosphere, the upper fluid surface gradually combines with the oxygen, and forms a greenish yellow powder. This is the first stage in the manufacture of red lead, and is carried out in the following manner:—In one of the buildings are several furnaces ranged in a row, of the form called reverberating, and of which a familiar idea may be given by comparing them to bakers' ovens. The pigs of lead (after the silver has been extracted from them) are put into the wide mouths of these furnaces, in the proportion of about a ton and a half of lead to each furnace. Flame is then admitted to act on the lead so as to melt it; and then begins the particular process by which the red lead is produced. A man stands before the open mouth of the furnace, as in the adjoining cut, provided with a long rake or stirrer. This stirrer is suspended by the middle from a chain

[Red Lead 'Stirring.']

overhead, so as to have greater facility of movement; and the man continually works and stirs the molten mass with this instrument. His object is to let every part of the metallic mass come in turn up to the surface, where it can come in contact with the air. This hot and tedious process is continued uninterruptedly for five or six hours; by which time the lead has lost its fluidity, its whitish colour, and its metallic lustre, and has become a greyish yellow powder.

It is not possible to convert the whole of the lead into powder by this means, since that which is formed must more or less prevent the remainder from having contact with the air. The contents of the furnace therefore become protoxide of lead mixed with metallic lead. To remove this metallic lead is the next process. The contents of the furnace are conveyed to an adjoining part of the buildings, where 'grinding stones,' 'settling' cisterns, and tanks point to a very different class of processes. The powder is put into a mill and ground till the lead itself is crushed to a fine state; and the whole is diffused in water in a cistern. The particles of metallic lead, being heavier than the rest, sink to the bottom; while the yellow powder becomes diffused through the water. The water, thus coloured of a bright yellow (for the greenish tinge had been caused by the blue lead mixed with the yellow powder) then flows through a series of tanks or troughs, arranged at such a slope that the liquid may be able to deposit its sediment of yellow oxide as it goes along; and this sediment is afterwards collected and dried.

Here we have a tolerably pure oxide of lead, which is called *massicot;* and by causing this to combine with a still larger portion of oxygen, it is converted into red lead, or minium. To effect this, the yellow powder is again put into reverberating furnaces, again heated, again stirred by a rake, and allowed to gather oxygen from the air for a much longer period than before. It changes its colour from a beautiful yellow to a fine red, passing through all the gradations of orange colour; or rather, this orange tint results from yellow particles and red particles being mixed in the same mass, and in different proportions as the process goes on. When finally removed from the furnace, it is ground a second time to a fine powder, and packed for sale.

In this instance, then, we see that heat and air, acting on metallic lead, convert it into *red lead;* but we shall now find that a different agency converts metallic lead into

White Lead.—The use of white lead in the arts is rather a humbling instance of the limit to our practical knowledge. Everybody says that white lead is injurious to the painters who use it; yet no one knows either how to do without it or how to remove its deleterious effects on the system. White lead forms the basis of nearly all the pigments used by the house-painter; and it possesses so many valuable properties for this purpose, that it has outlived all the objections made to it, and all the attempts made to supersede it.

There is a very curious circumstance connected with the manufacture, which would almost seem to show that this substance is not necessarily so deleterious as it is often said to be. Most of the processes are conducted by women. The white-lead manufacture is extensively carried on at Newcastle, and we believe that the employment of women in it is pretty general. Why this is the case we cannot say: time was, before Newcastle made the giant strides it has recently made, when the bricklayers' labourers of that town were of the feminine gender; and women may have accustomed themselves to employments generally undertaken by men elsewhere. But be this as it may, the women employed in the white-lead works at this factory certainly do not give countenance to the charge of unhealthiness brought against this manufacture; they look as healthy as the majority of females among the working classes, and are said to feel but little inconvenience from the employment. As to the circumstances in the social condition of the people which lead to the engagement of females in this way, it is a question too wide to be touched upon here, and therefore we proceed at once to the subject more immediately in view.

White lead is a carbonate of lead; and to make this carbonate, many plans are followed; but it will suffice for our purpose to notice the process as here conducted.

There are about a dozen lofty square rooms, in which this conversion of lead into carbonate of lead takes place; and the manner in which these rooms are gradually filled is singular enough. But we must first notice the form into which the lead is brought. Our frontispiece represents a cauldron or open vessel of iron, round which women are engaged. Pigs of lead are put into this cauldron, and melted by a fire beneath. When melted, the lead is leaden out of the cauldron into flat iron moulds, whereby thin sheets are formed about twenty inches long, four or five broad, and about an eighth of an inch thick. This the women do with great quickness; one stirring the molten lead to keep the surface clear, others casting the flat pieces, and others removing these pieces from the mould. When a sufficient number is collected, the pieces are put into a box or truck, and wheeled along a miniature railway to a place where

they are weighed; and when this weighing is finished, the thin pieces (weighing about five lbs. each) are ready to be applied to the next following process.

In the lofty square rooms a series of strata are built up one over another, to the height of twenty-five feet; and these strata are such as will certainly seem odd to most readers. At the bottom of all is a layer of fine ashes; next upon this is a layer of tanner's spent bark, two or three feet thick; then a layer of earthen pots,

[Setting the Beds for White Lead.]

about five inches in diameter, and containing each a pint of vinegar; then a layer of leaden plates, six in depth or thickness, laid over the open mouths of the pots; then a layer or covering of boards; next a second bed of spent tan, a second layer of pots containing vinegar, a second layer of leaden plates; and so on, until a 'stack,' as it is called, is built up to the height of more than twenty feet. Each layer of pots, with the tan beneath and the lead above, is called a 'heat,' or 'bed;' and the stack contains seven or eight of these heats when filled. There are about sixteen hundred pots ranged in each layer or heat; and four tons of lead in each heat laid on the pots; so that in all the successive series of tan, pots, and lead, there must be a mass of pretty considerable weight. The door of each room, if we may call it a door, is as high as the room itself; and each layer of the materials forms a floor on which the women stand and walk, as in the annexed cut, either to empty or to fill the stack. When all the arrangements are completed, the room is entirely closed up, and left untouched for many weeks.

Then comes the inquiry, what takes place in the stack during this period? The spent bark gradually ferments, and in so doing gives forth a considerable amount of heat (about 180° Fahr.), sufficient to cause the vinegar in the pots to evaporate slowly. This vapour is of a compound and acid character, and appears to act upon the thin sheets of lead placed over the pots in the following manner:—The surface of the lead is first converted into an oxide; this oxide is formed into an acetate by the vinegar; and this again changed into carbonate by carbonic acid gas yielded by the fermenting bark. In some factories other liquids are used instead of or mixed with vinegar, and other sources of heat than fermenting tan; and indeed there is some little chemical complexity involved in this change of metallic lead into white lead; but it will be sufficient for our purpose to know that the whole of the arrangements in the 'stack' are for the purpose of causing the thin pieces of lead to combine chemically with carbonic acid and oxygen to form white lead—a substance totally different from the lead whence it was prepared, since it is a white earthy-looking solid, wholly without lustre or metallic qualities.

As the stack had to be built up piecemeal, so now it has to be dissected layer by layer. The upper part of the door or entrance to the room is opened, and access gained to the interior. The women remove the uppermost sheets of lead, then the earthen pots (which have lost a good deal of their contents by evaporation), then a layer of bark, then a layer of boards, then a second tier of lead and of pots, then the next lower layer of bark; and so on, until the stack is entirely removed and the room emptied. All this is done in a stooping attitude, and is so far rather fatiguing; but there is no further difficulty in the matter.

The thin pieces of lead, thus removed from their prison-house, are perfectly white and earthy at the surface; but on examination they are found to be metallic in the centre. The acid gas has penetrated to a certain depth at both surfaces, but not so deep as to convert the whole mass into carbonate. Under this mode of manufacture there is generally about one half of the mass of lead converted into carbonate. To separate this white portion from the metallic lead, so that the latter may be re-melted and the former brought to the state of saleable white lead, is the next operation. The pieces are carried in flat boxes to another building, where there is a pair of revolving brass rollers working in a large vat of water. Each piece is put between the rollers, which are adjusted at such a distance apart that the white earthy matter is broken or crushed off, leaving the thin metallic film nearly separated from it. All alike fall into the water, the blue lead and the white lead; and a number of persons are then employed to rake and stir the mass to and fro. The white lead becomes suspended in the water, and passes through holes in the false bottom of the vessel; while the metallic lead which remains behind is gathered up, to be re-melted and re-cast into thin plates for the stack.

The thick creamy liquid passes from this vessel to various others, where the white lead suspended in the water is brought to a very fine state; grinding-mills, tanks of running water, and systems of pipes and pumps to convey the liquids to different levels, being among the apparatus employed for this purpose. At length, when brought to a state of very fine division, the white lead is allowed to settle to the bottom of the last vessel through which the liquid flows, and is thence removed in a paste-like state. To dry this paste is the next object of attention. In one part of the factory is a stove-room, so highly heated that a person unaccustomed to the employment cannot remain in it many minutes together; the temperature is indeed about 190° Fahr. Throughout the greater part of this stove-room are a number of iron rails or shelves, so placed one above the other as to contain many thousands of flat earthen dishes. Into these dishes the pasty mass is laded, to the extent of about ten or twelve pounds in each; and the dishes so filled are placed upon the shelves in the stove-room (the stove being at the time cold), there to remain till the white lead is quite dry.

One more building, and we shall have finished our tour of inspection. White lead is brought into the market in two forms: as a dry earthy substance; and as a kind of thick paint or paste ground up with linseed oil. To prepare this latter kind of commodity is the last process. There is in one of the buildings a vessel into which the white lead is placed, together with a given proportion of linseed oil. A stirrer or rake is kept constantly at work in mixing these two ingredients well together into a very stiff paste; and the mass then

flows out through a hole into the space between two grindstones or millstones, where it is ground up to a state of perfect smoothness and equality. To deposit this smooth product in casks, and to pack those casks carefully for the market, finally complete the range of processes.

There is thus, it will be perceived, a good deal of diversity in the ordeals which lead has to undergo in this factory. In one part of the premises the masses of lead are narrowly scrutinized, and made to give up the small but important quantity of silver which they may contain; in another they are made to assume the form of the bright little globules which the soldier and the sportsman make use of; in another the lead is made to give up its metallic character altogether, and to assume a red earthy form, in which there is neither lustre nor resonance nor tenacity; while in a fourth it is caused to assume the white form which is so indispensable to the painter.

We may here remark, that Newcastle is a busy emporium for the lead-trade in all its ramifications. There are extensive lead-mines in the western part of Northumberland; while the banks of the Tyne exhibit a considerable number of factories in which lead is brought to one or other of the many forms in which it is made applicable to the arts.

The north-west part of Newcastle having thus furnished us with a few interesting details, we will next go to the north-east, and glance at the arrangements of a manufacturing establishment, which is, on many accounts, worthy of notice, viz.,

Sopwiths' Cabinet-Factory.

Under general circumstances a cabinet-maker's manufactory is rather a workshop than what we should call a factory. It is usually a room of greater or less length, fitted up with ranges of work-benches near the windows; with stoves for melting the glue and drying the work; and with other appliances for carrying on the work. The processes, too, are rather of a handicraft than of a factory character: the workmen, by the aid of the saw, the plane, the chisel, the indispensable glue-pot, and other implements, working up their rough materials into the elegant forms which are familiar to us. Whether we call a maker of furniture by the rather vague names of "cabinet-maker" and "joiner," or as the Germans do in their word "tischler," by that of "table-maker," his employment of shaping pieces of wood and joining them together is pretty much the same, whether he is making a cabinet, a sideboard, a table, or any other article of furniture.

Were this the only point for notice, we should not enter upon any description here; but there are circumstances which render the cabinet-factory above alluded to worthy of a brief description, because science and art are here brought to bear upon each other in a manner mutually beneficial. One of the proprietors is a mining engineer, whose name is well known in connection with the scientific departments of mining economy, and who has done much to link together the theoretical with the practical in industrial pursuits. What we mean by science aiding art, and art aiding science, will appear as we go on.

The factory to which we are now directing our attention is situated out of the busy centre of Newcastle. It is in a northern suburb called Jesmond; one of those which have shared in the recent advancement of the town by new buildings. On the northern side of a clean and quiet street a large sliding gate gives entrance to an open court-yard, nearly an acre in extent; and opposite to the entrance is a range of buildings in which the manufacture is carried on in its earlier stages; while on the left is another range, appropriated to the finishing processes. The lower floor or stage of the buildings (which are three hundred feet in length) is occupied for the rougher purposes and for storehouses of various kinds, drying and packing rooms; while eastward are the mahogany-sheds, veneer-rooms, and saw-pits for supplying the raw material, occupying another two hundred feet of space. At the angle between the two sides of the building is a counting-house, or manager's room, so placed as to give a sort of "panopticon," as Bentham would have called it; that is, a "view on all sides," or to command a glance along two ranges of buildings and the whole of the court-yard and entrance at once. In various parts of the range are heated rooms for seasoning timber, reservoirs of water for extinguishing fires, and other arrangements on rather a large scale.

Immediately outside the entrance gates is a row of neat little houses, recently built by Mr. T. Sopwith, and inhabited chiefly by the workmen engaged in the factory. The houses of three of the foremen or managers (who, like the foremen in many concerns, are "old stagers," and, as it were, part and parcel of the firm) are placed on each side of the entrance gate. The houses are worthy of a little attention, especially at a time when the public sympathy is so warmly aroused in respect to the humbler dwellings in large towns. Why it is that the cellars of Liverpool, and the wretched hovels found in Manchester, Glasgow, and other manufacturing towns, should be such as they are, is a question too large to be answered briefly. Whether the dwellers cannot pay for better, or whether they cannot appreciate the comforts of better, or whether they cannot find better, because none others have been built, or whether they render bad worse by a disregard to habits of decency and cleanliness—or whether all these are combined—we do not pretend to say; but there can be no doubt that if those who build houses would pay a little more attention to the points which render houses clean and wholesome, they would confer a lasting benefit on those who have to become the in-dwellers, and would probably find in the end that it is quite as cheap to do a thing well as to do it slovenly. Mr. Chadwick's Report on the Sanitary Condition of Towns, and the statements of other writers who have paid any attention to the subject, afford sad evidence of the disastrous results following from ill-arranged dwellings.

The groups of houses are arranged four in a cluster, and are so managed that almost every room has two sides contiguous to the open air, as a means of avoiding the pent-up condition of rooms too generally built in humble neighbourhoods. In each group of four, the two centre houses are of two rooms each, one on the ground-floor and one above it; while the two end houses have four rooms, a front and back on each floor. The four houses are served by two entrance-passages, from each of which is an outlet to a yard behind; this yard, running behind all the four houses, obtains a more free current of air than if there were four very small ones; it is neatly flagged, and is provided with a pump, a dust-pit, coalhouses, and other outoffices, all removed from the houses themselves.

Most of the rooms are fitted so as to combine the comforts of a living and sleeping room, if the occupant cannot afford to have more than one. They are all of very good size, and contain a range, with an oven and boiler; so that the lamentable waste of heat which is so general from English fire-places, is here, in great part, avoided. If a family can afford to have a fire at all, there is abundant proof that, under the ordinary arrangement, much of the heat is absorbed by the brick-work around, instead of being made available for culinary matters; and many a working-man's home might have an increase of little comforts, without any increase of expense, if the English stoves in common use were

more fitted to act as cooking-stoves. The expense would be greater at the outset; but this is precisely the point at which the kindness and consideration of the proprietor of the houses would come advantageously into play, by a little enlarging his outlay. The arrangement of the houses in many minor respects is such as to encourage a free ventilation; and there is a general air of comfort within. The difference in the size of the houses is such as to accommodate persons having different means; since the same entrance-passage gives access on one side to a single room, and on the other to two rooms opening into each other. The general plan of these buildings appears to be very applicable to streets and houses for the labouring classes, a subject to which the attention of the Health of Towns Commission is now particularly devoted.

Returning again to the interior of the factory, we have a few points to mention respecting the operations carried on. The general articles of furniture manufactured, such as sofas, tables, sideboards, &c., involve the same mechanical processes wherever they are made, and do not demand particular description here. The show-rooms belonging to the firm, in the centre of Newcastle, like similar rooms in most large and flourishing towns, exhibit elegant specimens of what can be done in this art, and how a symmetrical piece of furniture can be wrought out of a rough-hewn block of wood. But there are two or three matters rather out of the usual path, which may fittingly be noticed.

Among the works under operation we observed a piece of furniture to which the name of *monocleid* is applied. This we may interpret to mean "single-lock," or "single-key," or "single-opening," and relates to the fact that one single lock fastens all the drawers and doors in a large and complex cabinet. Mr. Sopwith invented this piece of furniture, which may be designated generally a writing-cabinet, chiefly with a view to the wants of men of science or official persons, who have a multiplicity of papers and documents to preserve and to refer to repeatedly. This gentleman has himself the management of an extensive correspondence in relation to mines and engineering; and it was, we believe, to facilitate his own daily business that he contrived this very unique apparatus, the utility of which afterwards led to the establishment of it as a branch of manufacture. When the British Association held their meeting at Newcastle in 1838, the apparatus came under the notice of the Mechanical Section, in a communication which was thus noticed in the 'Athenæum' at the time: "The great loss of time to persons engaged in extensive official business, in consequence of the difficulty of arranging numerous sets of papers, and of obtaining access to them when so arranged, induced the author to take this opportunity of describing a table invented by himself, and which had been extremely serviceable to him. The principle is, that by opening a single lock, the whole of the drawers, closets, and partitions are opened. These are so disposed also as to admit of everything being reached without the person stirring from his seat. They are all entirely closed again by a single spring-lock. It would be impossible to convey a proper idea of this ingenious invention without sectional plans and elevations; but the President and many present expressed their admiration of the arrangements and of the convenience which such a table must be to every person engaged in an extensive correspondence, or having many sets of papers on various subjects. One contrivance is peculiarly worth mentioning. Within this case Mr. Sopwith hangs up his various keys. On any key being removed, a small counterbalance weight or bolt drops down, and remains down until the key is replaced. This bolt effectually prevents the closing of the case. If, then, the person should forget to replace the key which has been removed, he is immediately reminded of it by being unable to close the case. The principle and contrivances are applicable to many various arrangements of drawers and partitions."

There is one singular feature which we noticed in the "monocleid" not mentioned in the above description. The bed of the desk, or the flat surface which forms the sloping writing-desk, is itself the door to one of the closets or recesses of the cabinet. The apparatus may assume any one of many different forms; but the most customary form is that of a writing-table, with several small drawers beneath it, and a cabinet of recesses and drawers resting upon or above it. Now the cover of the largest recess turns on hinges at the bottom, and, according to its disposition, so is the whole apparatus closed or open. When this flap is turned up so as to form a door to the cabinet, all the drawers and doors are closed; when it is turned down so as to form a writing-desk, all the drawers and doors are open. If papers and writings be lying on the desk, this lid may be lifted up without disturbing them, and be made to shut them all up instantly, at the same time fastening all the other parts of the apparatus. The means of effecting this are by bolts and springs which pass down behind and through the various parts, establishing a chain of connection among them all. It is only those who have had much to do with papers and correspondence that can appreciate the convenience of such contrivances as this; and no one was more likely to have invented it than one who is himself so engaged.

A second point which we notice, because it connects the arts with the sciences in a manner rather out of the common way, is the manufacture of certain aids to science at this factory; among which are *levelling-staves* and *geological models*, the one employed in surveying and the other in illustrating mining and geological stratification. The levelling-staff is one of the instruments employed in ascertaining the contour of the ground for various engineering purposes: it consists of a series of rods, sliding one within another like the tubes of a telescope, and having springs and large figures, which supersede the use of the cross-vane, by which so much time was formerly lost. Instruments of this class are so little known except to professed surveyors, that it will suffice to say here that the kind now alluded to remedies certain defects observable in the common staves.

The geological models, however, open a field which ought to be known more or less to intelligent readers generally. Some of these are representations of extensive mining districts, showing not only the surface of the country, but also the various beds of mineral, and the situation and extent of the mines by which they are worked. Others, of a more popular character, and intended for general instruction, are small blocks of wood, a few inches square, composed of mahogany, satin-wood, beech, walnut-wood, and many different kinds of wood glued together. The actual mechanical construction is simply a species of fine cabinet-work, and is carried on by the more skilful of the workmen in the factory which we have noticed; the pieces being cut, and smoothed, and glued, much in the same way as other small specimens of fine wood-work. But the planning and directing are a different matter, and can only emanate from one who is at the same time a good geologist and a good mechanician. Each model represents a group of stratified rocks, such as really occur in nature; the strata being superposed more or less regularly, cropping out at the surface here and there, and exhibiting all the phenomena of veins, faults, upheavings, denudations, and other disturbances of regular stratification. Various coloured woods are employed to represent the different strata; and each model is capable of being dissected into several pieces, so as to show the internal

formation of the group of rocks intended to be imitated.

Whoever pays a visit to the Museum of Economic Geology in Craig's Court (and, being gratuitously opened by the government, it is certainly worth a visit from those who have an hour to spare) may see the manner in which these models are made to illustrate different classes of geological stratification. Mr. Sopwith has arranged the models in groups of six and of twelve each; and, taking this latter group, we find that it is made to illustrate the following points:—Denudation of stratified rocks; Coal strata near Newcastle; Dislocation of strata in carboniferous rocks; Superficial indications of coal; Dislocations of coal strata; Intersection of mineral veins; Surface denudation (or exposure by washing) of mineral veins; and exemplifications, chiefly of various geological phenomena which result from the effect produced at the surface of the ground by the particular angles at which the different strata lie.

It forms no part of our object to dwell on the scientific points connected with these illustrative models; but the models themselves, standing midway as it were between science and art, have called for some notice here, in connection with the factory where they are made. That they are, however, important aids to science is well admitted. Professor Buckland and Sir H. De la Beche have both noticed the advantages furnished by such models as these in practical geology and mining; they are adopted in the Universities as illustrations; and the Telford medal has been awarded to Mr. Sopwith by the Institute of Civil Engineers for the aid they afford to engineering generally.

Potteries.

We will find a little room here to say a few words respecting the potteries of this district, as one among the manufacturing features by which it is distinguished.

The banks of the Tyne and the banks of the Wear, the one river flowing into the sea at Shields, and the other at Sunderland, are seats of the pottery manufacture, generally of the coarser kinds. There are large supplies of clay found in the neighbourhood, fitted for brown ware, and every circumstance connected with the maintenance of manufacturing premises and the shipment of manufactured goods is so favourable, that the potteries of this district can successfully compete with those of Staffordshire in some particular goods, and altogether shut them out from some particular markets. The position of the pottery districts has a marked and striking influence on the foreign commerce to which the manufacture gives rise. Staffordshire lies nearly in the middle of the kingdom; and it is almost wholly dependent on canals for the means of transporting goods to foreign parts. Sound indeed were the reasons which induced the elder Wedgwood to forward the making of the Grand Trunk Canal, and to turn up the first sod with his own hands as the memento of a new era; for to that canal Staffordshire owes very much of what it now possesses. On the other hand, the counties of Durham and Northumberland, being bounded on the east by the sea, and having large navigable rivers flowing past busy towns to that sea, have at once the means of transshipment at command. Hence it has depended on a great many circumstances whether the centre or the margin of the country has succeeded in retaining any particular department of foreign trade. For all the foreign ports eastward of England, or bordering on the German Ocean, the more eastern of our potteries possess an obvious advantage, in respect to the short inland navigation required to bring the goods to the port of shipment; hence the firms at Newcastle, Sunderland, and the adjacent districts have very extensive dealings with Hamburg, and indeed with most of the ports all the way from Holland in the south to Hammerfest in the north; despatching shiploads of pottery at prices which these purchasers could not purchase at in their own countries or from their own countrymen. On the other hand, all those foreign countries which happen to be nearer to Liverpool than to the east coast, or which maintain a busy commercial intercourse with Liverpool, are likely, other things being equal, to see much more of Staffordshire pottery than of Northumbrian or Durham pottery; and we believe that such is the case with respect to Italian ports, among others.

The pottery of the district now under our notice does not comprise the beautiful porcelain, such as Worcester, Derby, and some firms in the Staffordshire district produce. There may be some of this made here; but the staple is wholly of a coarser kind, made to render rough and strong service, and to be sold at a low price. The St. Anthony's Pottery, situated on the northern shore of the Tyne, between Newcastle and Wallsend, is one of those in which a medium kind of ware is made, comprising various kinds of blue, white, and coloured ware, which is packed off to foreign ports in immense quantity. Other houses, again, confine their operations to a coarser kind of ware, in which the clay of the district can be used, instead of the more expensive clay of Cornwall and Devonshire.

As to the manufacturing arrangements connected with these potteries, we need not enter upon them; since they bear a general similarity, so far as they go, to those of Worcester and of Staffordshire, described in two former Nos. (700 and 716). All kinds consist mainly of clay, sometimes fine and sometimes coarse; and nearly all kinds contain flint, as an ingredient which helps to give a hard and vitreous character to the ware. In all, the ingredients are first ground fine while in a dry state, and then ground again in a wet state; but the degree to which this second grinding is carried, and the extent of the precautions taken to produce a fine and smooth mixture, depend upon the fineness of the ware to be made. Then, the clay being prepared, the same potter's wheel, or one of analogous construction, is employed to 'throw' the vessel to be made, whether it be a porcelain cup or one of rougher character; and the same 'handling,' drying, and firing, and glazing—modified to suit the altered circumstances—are carried out more or less in all. It is perhaps in the decorative parts subsequent to the firing that the chief differences, so far at least as a common observer can detect, are seen to exist; though, of course, every stage of the operations has its own peculiar gradations of excellence, according to circumstances.

As to the commercial features of the manufacture, taken with reference to the country generally, and not to its local distinctions, they are very interesting. According to the authority of Mr. M'Culloch, there were, in 1841, more than a million pieces of English earthenware (comprising all the various kinds) exported to Australia, a million and a half to Denmark, and an equal quantity to Ceylon; more than two millions each to Germany, Holland, the English West Indies, and the foreign West Indies; more than four millions to the North American Colonies, five millions to Brazil, and nineteen millions to the United States; together with minor quantities to other countries, making in the whole fifty-three millions of pieces!

We have yet a little more to say respecting the busy Tyne and its manufactures; but enough for the present.